

CLAIMS

1. A method for recording information to a recording medium having at least a first recording layer and a second recording layer, the first recording layer having a data area comprising an inner side located at a radially inner region of the recording medium and an outer side located at a radially outer region of the recording medium and the second recording layer comprising a data area including an inner side located at the radially inner region of the recording medium and an outer side located at the radially outer region of the recording medium, the method comprising:

performing a first formatting process on the data area of the second recording layer, said first formatting process comprising formatting said data area of the second recording layer in a series of recording increments, the series of recording increments progressing from the inner side of the data area of the second recording layer to the outer side of the data area of the second recording layer, wherein within each recording increment the formatting is performed along a path extending from the outer side of the data area of the second recording layer to the inner side of the data area of the second recording layer;

performing a second formatting process on the data area of the first recording layer once the first formatting process has been completed, the second formatting process being performed along a path

5 extending from the inner side of the data area of the first recording layer to the outer side of the data area of the first recording layer.

2. A method according to claim 1, wherein the
10 recording medium is adapted to be recorded using a laser, and the first recording layer is the recording layer closest the laser during use.

3. A method according to claim 1 or 2,
15 wherein the recording medium is associated with an order of recording user data for each recording layer, and the first recording layer is arranged to be earlier in the recording order than the second recording layer.

20 4. A method according to any one of claims 1 to 3, further comprising recording user data on a data area of the first recording layer along a path extending from the inner side of the data area of the first recording layer to the outer side of the data area of
25 the first recording layer on receipt of a request to

record user data.

5. A method according to claim 4, wherein on
receiving a request to record user data, the method
5 comprises recording the user data in priority to the
performing the first formatting process or the second
formatting process.

6. A method according to claim 4 or 5,
10 further comprising resuming the first formatting process
after recording the user data if the first formatting
process is not complete.

7. A method according to any one of claims 4
15 to 6, further comprising resuming the second formatting
process after recording the user data if the first
formatting process is complete.

8. A method according to any one of claims 4
20 to 7, further comprising:

recording predetermined data on the first
recording layer at a position immediately after recorded
user data on receipt of a request to eject the recording
medium.

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9. A method according to claim 8, further comprising:

recording predetermined data on the second recording layer at a corresponding radial position to
5 the predetermined data on the first recording layer.

10. A method according to claim 8, further comprising:

recording predetermined data on the second
10 recording layer at the bit inverted addresses to the addresses of the predetermined data on the first recording layer.

11. A method according to any one of claims 4
15 to 10, wherein on receipt of a request to eject the recording medium, if an end position of the user data on the first recording layer is further in the radially outer direction of the recording medium than an end position of formatted data on the second recording layer,
20 then the method further comprises:

performing a formatting process on the data area of the second recording layer so as to make the radial position of the end position of formatted data on the second recording layer correspond to the radial
25 position of the end position of the user data on the

first recording layer.

12. A method according to any one of claims 4
to 11, wherein on receipt of a request to eject the
5 recording medium, if an end position of the recording of
the user data on the first recording layer is further in
the radially outer direction of the recording medium
than an end position of formatted data on the second
recording layer, then the method further comprises:
10 performing a formatting process on the data
area of the second recording layer so as to make the
address of the end position of formatted data on the
second recording layer be the bit inverted address of
the address of the end position of the user data on the
15 first recording layer.

13. A method according to any one of claims 1
to 12, wherein on receipt of a request to eject the
recording medium, the method further comprises:
20 obtaining a last recorded position of data on
said recording medium;
recording, when formatting has been completed
to a position of each recording layer corresponding to
said last recorded area, predetermined data at a
25 position immediately after said last recorded position

in the recording layer having said last recorded position and at a position immediately after a position corresponding to said last recorded position in each recording layer in which the data is not recorded; and

5 ejecting said recording medium after recording the predetermined data.

14. A method according to any one of claims 1 to 12, wherein on receipt of a request to eject the recording medium, the method further comprises:

obtaining a last recorded position of data on said recording medium;

obtaining a format end position of each recording layer in which the data is not recorded yet;

15 recording dummy data, when an area from said last recorded position to a position corresponding to said format end position is an unrecorded area with respect to one of the recording layers having said last recorded position of the data in accordance with said last recorded position and said format end position, the dummy data being recorded in the area from said last recorded position to the position corresponding to said format end position;

25 recording predetermined data at a position immediately after the recorded dummy data in each

recording layer having said last recorded position of the data, at a position immediately after said format end position in the recording layer having said format end position, and at a position corresponding to said format end position in each recording layer in which data is not recorded yet and formatting has completed; and

ejecting said recording medium after recording the predetermined data.

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15. A method according to any one of claims 1 to 14, wherein the recording medium is an optical disk.

16. An information recording apparatus arranged to record data on a recording medium having at least a first recording layer and a second recording layer, the first recording layer having a data area comprising an inner side located at a radially inner region of the recording medium and an outer side located at a radially outer region of the recording medium and the second recording layer comprising a data area including an inner side located at the radially inner region of the recording medium and an outer side located at the radially outer region of the recording medium, the apparatus being arranged to:

format the data area of the second recording layer of the recording medium according to a first formatting process, said first formatting process comprising formatting said data area of the second recording layer in a series of recording increments, the series of recording increments progressing from the inner side of the data area of the second recording layer to the outer side of the data area of the second recording layer, wherein within each recording increment the formatting is performed along a path extending from the outer side of the data area of the second recording layer to the inner side of the data area of the second recording layer;

format a data area of the first recording layer of the recording medium according to a second formatting process once the first formatting process has been completed, the second formatting process being along a path extending from the inner side of the data area of the first recording layer to the outer side of the data area of the first recording layer.

17. Apparatus according to claim 16, wherein the apparatus is adapted to record data on the recording medium using a laser, wherein the first recording layer is the recording layer closest the laser during use.

18. Apparatus according to claim 16 or 17,
wherein the recording medium is associated with an order
of recording user data for each recording layer, and the
first recording layer is arranged to be earlier in the
5 recording order than the second recording layer.

19. Apparatus according to any one of claims
1 to 18, wherein the apparatus is further arranged to
record user data on a data area of the first recording
10 layer along a path extending from the inner side of the
data area of the first recording layer to the outer side
of the data area of the first recording layer on receipt
of a request to record user data.

15 20. Apparatus according to claim 19, wherein
on receipt of a request to record user data, the
apparatus is further arranged to record the user data in
priority to the performing the first formatting process.

20 21. Apparatus according to claim 19 or 20,
wherein the apparatus is further arranged to resume
performing the first formatting process after recording
the user data if the first formatting process is not
complete.

22. Apparatus according to any one of claims
19 to 21, wherein the apparatus is further arranged to
resume performing the second formatting process after
recording the user data if the first formatting process
5 is complete.

23. Apparatus according to any one of claims
19 to 22, wherein the apparatus is further arranged to
record predetermined data on the first recording layer
10 at a position immediately after recorded user data on
receipt of a request to eject the recording medium.

24. Apparatus according to claim 23, wherein
the apparatus is further arranged to record
15 predetermined data on the second recording layer at a
corresponding radial position to the predetermined data
on the first recording layer.

25. Apparatus according to claim 23, wherein
20 the apparatus is further arranged to record
predetermined data on the second recording layer at the
bit inverted addresses to the addresses of the
predetermined data on the first recording layer.

25 26. Apparatus according to any one of claims

16 to 25, wherein the apparatus is further arranged such that on receipt of a request to eject the recording medium, if an end position of the recording of the user data on the first recording layer is further in the radially outer direction of the recording medium than an end position of formatted data on the second recording layer, then the apparatus is further arranged to:

format the data area of the second recording layer so as to make the radial position of the end position of formatted data on the second recording layer correspond to the radial position of the end position of the user data on the first recording layer.

27. Apparatus according to any one of claims 16 to 26, wherein the apparatus is further arranged such that on receipt of a request to eject the recording medium, if an end position of the recording of the user data on the first recording layer is further in the radially outer direction of the recording medium than an end position of formatted data on the second recording layer, then the apparatus is further arranged to:

format the data area of the second recording layer so as to make the address of the end position of formatted data on the second recording layer be the bit inverted address to the address of the end position of

the user data on the first recording layer.

28. Apparatus according to any one of claims
16 to 27, wherein on receipt of a request to eject the
5 recording medium, the apparatus is adapted to:

obtain a last recorded position of data on
said recording medium;

record, when formatting has been completed to
a position of each recording layer corresponding to said
10 last recorded area, predetermined data at a position
immediately after said last recorded position in the
recording layer having said last recorded position and
at a position immediately after a position corresponding
to said last recorded position in each recording layer
15 in which the data is not recorded; and

eject said recording medium after recording
the predetermined data.

29. Apparatus according to any one of claims
20 16 to 28, wherein on receipt of a request to eject the
recording medium, the apparatus is adapted to:

obtain a last recorded position of data on
said recording medium;

obtain a format end position of each recording
25 layer in which the data is not recorded yet; record

dummy data, when an area from said last recorded position to a position corresponding to said format end position is an unrecorded area with respect to one of the recording layers having said last recorded position of the data in accordance with said last recorded position and said format end position, the dummy data being recorded in the area from said last recorded position to the position corresponding to said format end position;

10 record predetermined data at a position immediately after the recorded dummy data in each recording layer having said last recorded position of the data, at a position immediately after said format end position in the recording layer having said format end position, and at a position corresponding to said
15 format end position in each recording layer in which data is not recorded yet and formatting has completed; and

 eject said recording medium after recording
20 the predetermined data.

 30. Apparatus according to any one of claims 16 to 29, wherein the recording medium is an optical disk.

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31. An information recording and reproducing apparatus configured and arranged to record data on and reproduce data from each of a plurality of recording layers of a recording medium, comprising:

5 a controller that controls a formatting process to format said recording medium by starting from one of the recording layers of which recording order of data is latest and progressing the formatting from one of the recording layers of which the recording order is
10 later toward one of the recording layers of which the recording order is earlier.

32. An information recording and reproducing apparatus as claimed in claim 31, wherein said recording
15 medium is an optical disc, and said controller controls to start the formatting process of each of the recording layers from an inner side of said optical disc.

33. An information recording and reproducing
20 apparatus as claimed in claim 31, wherein said controller controls an eject process to eject said recording medium from said information recording and reproducing apparatus so as to obtain a last recorded position of data on said recording medium when an
25 instruction of ejecting said recording medium is made;

record, when formatting has been completed to a position
of each recording layer corresponding to said last
recorded area, predetermined data at a position
immediately after said last recorded position in the
5 recording layer having said last recorded position and
at a position immediately after a position corresponding
to said last recorded position in each recording layer
in which the data is not recorded; and eject said
recording medium after recording the predetermined data.

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34. An information recording and reproducing
apparatus as claimed in claim 31, wherein said
controller controls an eject process to eject said
recording medium from said information recording and
15 reproducing apparatus so as to obtain a last recorded
position of data on said recording medium when an
instruction of ejecting said recording medium is made;
obtain a format end position of each recording layer in
which the data is not recorded yet; record dummy data,
20 when an area from said last recorded position to a
position corresponding to said format end position is an
unrecorded area with respect to one of the recording
layers having said last recorded position of the data in
accordance with said last recorded position and said
25 format end position, the dummy data being recorded in

the area from said last recorded position to the position corresponding to said format end position; record predetermined data at a position immediately after the recorded dummy data in each the recording layer having said last recorded position of the data, at a position immediately after said format end position in the recording layer having said format end position, and at a position corresponding to said format end position in each recording layer in which data is not recorded yet and formatting has completed; and eject said recording medium after recording the predetermined data.

35. An information recording and reproducing apparatus configured and arranged to record data on and reproduce data from each of a plurality of recording layers of a recording medium, comprising:

formatting means for formatting said recording medium by starting from one of the recording layers of which recording order of data is latest and progressing the formatting from one of the recording layers of which the recording order is later toward one of the recording layers of which the recording order is earlier.

36. An information recording and reproducing apparatus as claimed in claim 35, wherein said recording

medium is an optical disc, and said formatting means includes means for starting the formatting of each of the recording layers from an inner side of said optical disc.

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37. An information recording and reproducing apparatus as claimed in claim 35, further comprising:

means for obtaining a last recorded position of data on said recording medium when an instruction of
10 ejecting said recording medium is made;

means for recording, when formatting has been completed to a position of each recording layer corresponding to said last recorded area, predetermined data at a position immediately after said last recorded
15 position in the recording layer having said last recorded position and at a position immediately after a position corresponding to said last recorded position in each recording layer in which the data is not recorded; and

20 means for ejecting said recording medium after recording the predetermined data.

38. An information recording and reproducing apparatus as claimed in claim 35, further comprising:

25 means for obtaining a last recorded position

of data on said recording medium when an instruction of ejecting said recording medium is made;

means for obtaining a format end position of each recording layer in which the data is not recorded yet;

means for recording dummy data, when an area from said last recorded position to a position corresponding to said format end position is an unrecorded area with respect to one of the recording layers having said last recorded position of the data in accordance with said last recorded position and said format end position, the dummy data being recorded in the area from said last recorded position to the position corresponding to said format end position;

means for recording predetermined data at a position immediately after the recorded dummy data in each the recording layer having said last recorded position of the data, at a position immediately after said format end position in the recording layer having said format end position, and at a position corresponding to said format end position in each recording layer in which data is not recorded yet and formatting has completed; and

means for ejecting said recording medium after recording the predetermined data.

39. A method of controlling an information recording and reproducing apparatus configured and arranged to record data on and reproduce data from each of a plurality of recording layers of a recording medium,
5 the method comprising:

a formatting step of formatting said recording medium by starting from one of the recording layers of which recording order of data is latest and progressing the formatting from one of the recording layers of which
10 the recording order is later toward one of the recording layers of which the recording order is earlier.

40. A method of controlling an information recording and reproducing apparatus as claimed in claim
15 39, wherein said recording medium is an optical disc, and said formatting step includes a step of starting the formatting of each of the recording layers from an inner side of said optical disc.

20 41. A method of controlling an information recording and reproducing apparatus as claimed in claim 39, further comprising:

a step of obtaining a last recorded position of data on said recording medium when an instruction of
25 ejecting said recording medium is made;

a step of recording, when formatting has been completed to a position of each recording layer corresponding to said last recorded area, predetermined data at a position immediately after said last recorded position in the recording layer having said last recorded position and at a position immediately after a position corresponding to said last recorded position in each recording layer in which the data is not recorded; and

10 a step of ejecting said recording medium after recording the predetermined data.

42. A method of controlling an information recording and reproducing apparatus as claimed in claim 15 39, further comprising:

a step of obtaining a last recorded position of data on said recording medium when an instruction of ejecting said recording medium is made;

20 a step of obtaining a format end position of each recording layer in which the data is not recorded yet;

a step of recording dummy data, when an area from said last recorded position to a position corresponding to said format end position is an unrecorded area with respect to one of the recording

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layers having said last recorded position of the data in accordance with said last recorded position and said format end position, the dummy data being recorded in the area from said last recorded position to the

5 position corresponding to said format end position;

a step of recording predetermined data at a position immediately after the recorded dummy data in each the recording layer having said last recorded position of the data, at a position immediately after
10 said format end position in the recording layer having said format end position, and at a position corresponding to said format end position in each recording layer in which data is not recorded yet and formatting has completed; and

15 a step of ejecting said recording medium after recording the predetermined data.